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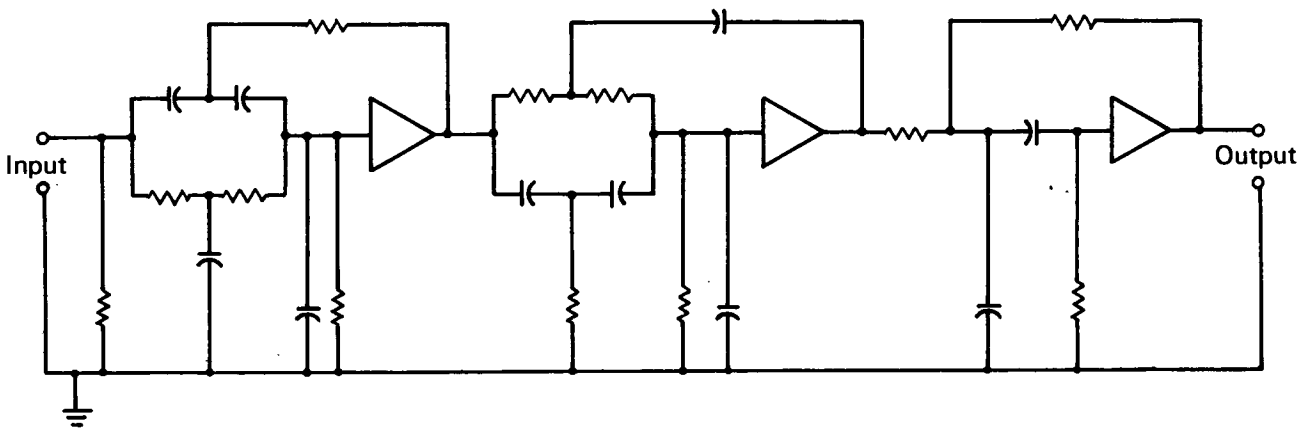
NASA TECH BRIEF

High-Performance RC Bandpass Filter Is Adapted to Miniaturized Construction



The problem:

To design a sixth-order unsymmetrical bandpass filter suitable for use in integrated circuits.

The solution:

A bandpass filter using RC networks (in place of LC networks) in a form suitable for integrated circuits. The circuit consists of three stages of amplification with additional resistive and capacitive components to obtain the desired characteristics.

How it's done:

Three stagger-tuned stages are used as the basic structure with modifications to allow for the asymmetric infinite attenuation points. Each stage uses passive RC components and an amplifier that acts as an ideal voltage-controlled voltage source of low gain. Parallel ladder networks are used in two of the stages, both to provide the finite zeros and as feedback configurations to realize the desired complex conjugate poles. These networks permit completely independent selection of the pole and zero positions. A somewhat simpler RC network in the third stage provides the zeros at the origin and at infinity, and the third set of complex conjugate poles.

The amplifiers are suitable for cascade connection, without the use of coupling or bypass capacitors. In addition, they have very high gain stability, an input impedance exceeding 20 megohms, and an output impedance less than 20 ohms. Each amplifier uses 3 transistors and 5 resistors. In its present form, the amplifier has a frequency response of dc to 5 mc. The networks used require gains of between 1 and 4, and the amplifier provides an open-loop voltage gain of greater than 1,000, thereby allowing excellent stability as a result of the feedback employed.

The RC circuit has exceeded a comparable LC circuit in notch rejection at 5 kc and 15 kc, and produced a gain of 500 in the pass band, which is 2 kc wide, centered at 10 kc. Temperature tests have shown less than 1 percent overall system gain change from room temperature to 100° C.

(continued overleaf)

Notes:

1. The primary advantages of the active RC filter network are in the reduction in size and weight achieved and in the elimination of magnetic materials. The latter advantage is particularly important in instruments used for measuring very weak magnetic fields.
2. Even without using integrated circuitry techniques, this complete filter–amplifier could be packaged in a 1-inch cube using off-the-shelf, discrete components.
3. Further information concerning this innovation is given in "The Design of High Performance Active RC Bandpass Filters," by William J. Kerwin and L. P. Huelsman in a paper for the 1966 IEEE International Convention March 21-26, 1966, New York, N.Y. Inquiries may also be directed to:

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Patent status:

No patent action is contemplated by NASA.

Source: (ARC-60)